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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte JEFFREY HAROLD, DAVID MORGAN, and SHALABH CHANDRA

Appeal 2008-4413
Application 09/990,518
Technology Center 3700

Decided: January 30, 2009

Before ERIC GRIMES, LORA M. GREEN, and RICHARD M. LEBOVITZ, *Administrative Patent Judges*.

GRIMES, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 involving claims to a medical imaging system and method, which the Examiner has rejected as obvious. We have jurisdiction under 35 U.S.C. § 6(b). We affirm.

STATEMENT OF THE CASE

The Specification discloses that "multi-slice or multi-detector CT [computed tomography imaging] enables an increased anatomical coverage and/or increased longitudinal (z-axis) resolution relative to so called single-slice CT" (Spec. 1, ¶ 0002). "[M]ulti-slice CT typically results in hundreds of thin (e.g., on the order of 0.5 mm thick) axial cross-section slices/images per case or scan" (*id.*). The large number of high-resolution images provide increased detail but can be time-consuming to review for areas where high resolution is not required (*id.* at ¶ 0003).

The Specification discloses a method in which "thin slices" (i.e., "the individual slices or axial cross-section images originally generated and/or collected by the multi-slice CT scanner" (*id.* at 7, ¶ 0028)) are combined to create "thick slices" (*id.* at 7, ¶ 0029). The Specification also discloses a system for carrying out the disclosed method (see, e.g., *id.* at 3, ¶ 0007).

The disclosed system and method allow the thick, lower-resolution images to be viewed in one view port[1] while the constituent thin, higher-resolution images are simultaneously displayed in another view port, allowing efficient review of the images at the desired level of resolution (*id.* at 3, ¶ 0007; 11, ¶ 0039).

Claims 1-18 and 20 are pending and on appeal. Claims 2-5, 7-9, 12, 16, 17, and 20 have not been argued separately and therefore stand or fall with the independent claim they depend on. 37 C.F.R. § 41.37(c)(1)(vii).

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[1] A view port can be a separate monitor or a window on a monitor (Spec. 8, ¶ 0030).

Claims 1, 6, and 15, the independent claims, are representative and read as follows:

1. A diagnostic medical imaging system comprising:

an imaging apparatus having an examination region in which a subject being examined is positioned, said imaging apparatus obtaining a plurality of first image slices of the subject, said first image slices having a first thickness;

a storage device into which the first image slices are loaded;

a data processor which combines subsets of first image slices to generate a plurality of second image slices having a second thickness greater than the first thickness, said subsets each including a number n of contiguous first image slices, where n is an integer, said second image slices corresponding to a second thickness which is n times the first thickness, the first and second slices being parallel to each other; and,

a display having a plurality of view ports including a first view port which depicts one or more selected second image slices and a second view port which depicts one or more first image slices which are constituents of one of the second image slices depicted in the first view port.

6. A diagnostic medical imaging system for examining a subject, said medical imaging system comprising:

acquisition means for obtaining a plurality of first image slices of the subject, said first image slices corresponding to a first thickness;

combining means for generating a plurality of second image slices from combined subsets of first image slices, said subsets including a plural number n of contiguous first image slices, said second image slices corresponding to a second thickness which is n times the first thickness, the first and second slices being parallel to each other;

first display means for displaying selected ones of the plurality of second image slices; and,

second display means for displaying one or more of the first image slices included in the subset used to generate one the second image slices being displayed by the first displaying means.

15. A method of diagnostic medical imaging, said method comprising:

(a) obtaining a plurality of first 2D images of a subject, said first images representing a plurality of contiguous slices of a first thickness;

(b) generating a plurality of second 2D images from subsets of the first images by merging together the first images in each subset, said subsets including first images for a number of the contiguous slices they represent, said second images representing slices of a second thickness which is greater than the first thickness;

(c) designating regions of the subject for close review by a reviewer;

(d) sequentially displaying the second images for review by the reviewer; and,

(e) displaying the first images for review by the reviewer when the designated regions are reached.

The claims stand rejected under 35 U.S.C. § 103 as follows:

- Claims 6-18 as obvious in view of Horiuchi[2] and Wood;[3] and
- Claims 1-5 and 20 as obvious in view of Horiuchi, Wood, and Lonn.[4]

OBVIOUSNESS

The Issue

The Examiner has rejected all of the claims as obvious based on Horiuchi and Wood, or Horiuchi, Wood, and Lonn. The Examiner's position is that Horiuchi discloses the method and system of independent claims 6 and 15 except for the limitation requiring multiple view ports (Answer 5) and discloses the system of claim 1 except for the limitations requiring (a) multiple view ports and (b) thick slices that are n times as thick

[2] Horiuchi, U.S. Patent 6,137,858, issued Oct. 24, 2000.
[3] Wood et al., US 2002/0070970 A1, published June 13, 2002.
[4] Lonn, U.S. Patent 5,241,576, issued Aug. 31, 1993.

as the thin slices, where n is an integer (*id.* at 3, 4). The Examiner concludes that the limitations missing from Horiuchi would have been obvious based on Wood or Wood combined with Lonn (*id.* at 3-4, 5, 6).

Appellants contend that the cited references do not make obvious the inventions defined by the independent claims because the prior art combines raw CT image *data*, not images per se as required by the claims (see, e.g., Appeal Br. 14; Reply Br. 3-6).

The main issue presented for decision, therefore, is: Do the cited references disclose or make obvious a system and method that combines thinner "images" (or "image slices") to form thicker "images" (or "image slices)," as recited in claims 1, 6, and 15?

Findings of Fact

1. Horiuchi discloses a method and apparatus for radiation tomography, including computed tomography (CT) (Horiuchi, col. 1, ll. 5-12).

2. Horiuchi's system includes an apparatus for generating a plurality of contiguous image slices of a subject (*id.* at col. 6, ll. 5-20).

3. Horiuchi's system includes a storage device and a display device (*id.* at col. 4, ll. 49-53; Fig. 1).

4. Horiuchi's system includes a CPU (i.e., data processor) that reconstructs images based on the CT data (*id.* at col. 4, ll. 32-36, 53-56).

5. Horiuchi discloses

> a radiation tomography method comprising the steps of: with a projection image of a subject projected by a radiation beam having an extent and a thickness divided into divided projection images . . . , measuring their respective projection data . . . ; and

> producing tomographic images respectively based on the projection data for each of the divided projection images and the projection data for all of the divided projection images.

(*Id.* at col. 1, ll. 57-65.)

6. Horiuchi discloses that "the division is preferably unequal division" (*id.* at col. 1, ll. 66-67).

7. In one example, Horiuchi discloses that "the slice thickness is set to 10 mm, and its division is set to the dividing ratio 7:3," which produces divided projection images with thicknesses of 7 mm and 3 mm (*id.* at col. 6, ll. 45-47, 55-60).

8. Horiuchi discloses that the thicknesses of the thinner slices and the combined slice are set by the user (*id.* at col. 6, ll. 47-49).

9. "[T]he projection data sets for the two slices are then added for each scan location. . . . This addition generates projection data corresponding to the slice thickness of the combined two slices, i.e., equivalent to projection data for a 10-mm slice" (*id.* at col. 7, ll. 13-18).

10. Image reconstruction is then performed for each of the 3 mm, 7 mm, and combined 10 mm slices: "Thus, three tomographic images which differ in slice thickness are obtained for each scan location" (*id.* at col. 7, ll. 19-27).

11. Horiuchi discloses that a "low frequency band enhancing reconstruction function is used" in reconstructing the images from the 10 mm and 7 mm slices, and a "high frequency band enhancing reconstruction function" is used in reconstructing the images from the 3 mm slice (*id.* at col. 7, ll. 36-44).

12. Horiuchi discloses that the exemplary method results in a series of contiguous 10 mm slices over the entire imaged field, and "a plurality of detailed tomographic images representing 3-mm slices imaged at regular intervals" (*id.* at col. 7, ll. 48-49).

13. "By observing the plurality of tomographic images representing the 10-mm slices . . . , one can examine the entire lung field contiguously and exhaustively. Moreover, by observing the plurality of tomographic images representing the 3-mm slices . . . , one can precisely examine the lung field at regular intervals." (*Id.* at col. 7, ll. 59-65.)

14. Horiuchi discloses that its method can also be carried out using a detector array having more than two rows (i.e., generating more than two slices per scan): "This is preferable in that tomographic images as many as four or more can be obtained at a time." (*Id.* at col. 8, ll. 5-7.)

15. Lonn discloses that "[i]n clinical application [of CT scanning] the thickness of the slice 15 taken through the patient may be varied from very thin (1 mm) to very thick (10 mm)" (Lonn, col. 1, ll. 64-66).

16. Lonn discloses that "[a]s the thickness of the slice is increased, the reconstructed image becomes more susceptible to partial volume artifacts" (*id.* at col. 2, ll. 4-6).

17. Lonn discloses that one approach to "dealing with this partial volume artifact problem when imaging thick slices . . . is to acquire the thick slice as a series of separate, but contiguous thin slices" (*id.* at col. 2, ll. 26-34).

18. Lonn discloses that this approach requires more time for data acquisition and data processing, and limits the volume that can be scanned (*id.* at col. 2, ll. 40-51).

19. Lonn discloses "an x-ray CT scanner in which each x-ray detector element is comprised of a set of detector sub-elements which are disposed along the slice thickness direction and which each produce a thin slice attenuation signal; . . . [and] summing means for producing a thick slice attenuation signal from the preprocessed thin slice attenuation signal[s]" (*id.* at col. 2, ll. 57-64).

20. Lonn discloses that, "[f]or example, eight 1 mm thin slice attenuation signals may be separately summed to form two 4 mm thick slice attenuation signals that are employed to reconstruct two separate images" (*id.* at col. 3, ll. 35-38).

21. Lonn discloses another embodiment in which "fifteen sub-elements 60_1-60_{15} are employed in the detector 14, with each sub-element measuring a thin slice of 1 mm in thickness" (*id.* at col. 7, ll. 8-10).

22. Lonn discloses that "the thin slice attenuation signals for the respective detector segments 60_1-60_5, 60_6-60_{10} and 60_{11}-60_{15} can be summed together to form three 5 mm thick slices, or the successive sets of three thin slice attenuation signals can be summed to form five separate 3 mm thick slices" (*id.* at col. 7, ll. 44-49).

23. Lonn discloses that, more generally, "[a]nywhere from one to fifteen separate transmission profiles can thus be acquired for each view during the scan, and at the completion of the scan anywhere from one to

fifteen separate images can be reconstructed from the resulting raw data arrays" (*id.* at col. 7, ll. 49-53).

24. Wood discloses a method and system for displaying CT images in which different images are displayed simultaneously in different view ports (Wood, p. 3, ¶ 0043; Fig. 5).

Principles of Law

"The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, __, 127 S. Ct. 1727, 1739 (2007). "[W]hen the question is whether a patent claiming the combination of elements of prior art is obvious," the answer depends on "whether the improvement is more than the predictable use of prior art elements according to their established functions." *Id.* at __, 127 S. Ct. at 1740.

"[I]n a section 103 inquiry, 'the fact that a specific [embodiment] is taught to be preferred is not controlling, since all disclosures of the prior art, including unpreferred embodiments, must be considered.'" *Merck & Co. Inc. v. Biocraft Laboratories Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989) (quoting *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976)).

"An intended use or purpose usually will not limit the scope of the claim because such statements usually do no more than define a context in which the invention operates." *Boehringer Ingelheim Vetmedica v. Schering-Plough Corp.*, 320 F.3d 1339, 1345 (Fed. Cir. 2003).

Analysis

Horiuchi discloses an imaging system comprising an imaging apparatus that obtains image slices of a subject, a storage device, and a data processor, as required by claim 1. Horiuchi's system also includes a display. Horiuchi does not expressly suggest a plurality of view ports, but Wood discloses a CT display with multiple view ports for displaying different CT images, and therefore would have made it obvious to modify Horiuchi's system to include multiple displays or multiple windows within a single display.

Claim 1 also requires that the data processor combine subsets of n first image slices, where n is an integer, to generate second image slices having a thickness n times that of the first image slices. That is, n thin slices of equal thickness are combined to generate a thick slice n times as thick as each thin slice.

Horiuchi discloses combining data from two thinner slices to generate a thicker slice, and reconstructing images corresponding to all three slices. Horiuchi does not expressly suggest that the two thinner slices should be the same thickness. However, Horiuchi discloses that the two thinner slices are "preferably" of unequal thickness, and thus discloses an embodiment (albeit unpreferred) in which the thin slices are of the same thickness.

In addition, Lonn discloses generating CT image data in thin slices of equal thickness that can be combined to create a thicker slice n times as thick as each thin slice. Therefore, it would have been obvious to a person of ordinary skill in the art to modify Horiuchi's apparatus to generate

contiguous, thin slices of equal thickness and combine them in order to create a thicker slice twice as thick as each of the thin slices.

Finally, claim 1 states that the plurality of view ports "includ[e] a first view port which depicts one or more selected second image slices and a second view port which depicts one or more first image slices which are constituents of one of the second image slices depicted in the first view port." This language, however, merely recites the intended use of the view ports that are part of the claimed apparatus; it does not place any limit the structure of the apparatus. It is therefore not a claim limitation.

We agree with the Examiner that the combined teachings of Horiuchi, Wood, and Lonn would have made the apparatus of claim 1 obvious to a person of ordinary skill in the art.

Claim 6 is similar to claim 1 but is written in the means-plus-function language of 35 U.S.C. § 112, sixth paragraph. The "means" recited in claim 6 correspond to the structures recited in claim 1 as follows:

Claim 6	Claim 1
"acquisition means for obtaining a plurality of first image slices . . . "	"an imaging apparatus . . . obtaining a plurality of first image slices . . . "
"combining means for generating a plurality of second image slices from combined subsets of first image slices . . . "	"a data processor which combines subsets of first image slices to generate a plurality of second image slices . . . "
"first display means" and "second display means"	"a display having a plurality of view ports"

For the reasons discussed above with respect to claim 1, the combined teachings of Horiuchi and Wood also would have made the system of claim 6 obvious to a person of ordinary skill in the art.

Appellants argue that claims 1 and 6, and the claims that depend on them, would not have been obvious in view of the cited references because the claims require combining *images* while the references combine *image data*. (See Appeal Br. 13 ("Horiuchi combines pre-reconstruction image data and does not combine images."); *id.* at 14 ("Like Horiuchi, Lonn does not combine images. Rather, Horiuchi [sic, Lonn] combines the outputs of detectors prior to reconstruction."); Reply Br. 3 ("Because the portions of Horiuchi upon which the Examiner is relying relate to raw CT data; whereas, claim 1 refers to images, i[t] is submitted that the Examiner has not shown the claimed concepts in the references."); *id.* at 4 ("The Examiner's assertion that Lonn combines thinner image slices is again flawed for analogous reasons. Specifically, Lonn is concerned with combining raw CT image data prior to reconstruction.").

This argument is not persuasive. Appellants have cited no evidence that those skilled in the art recognized a functional distinction between "images" per se and "image data." Such a distinction is not supported by the evidence of record. The Specification uses the terms "image" and "image data" interchangeably. (See, e.g., Spec. 6, ¶ 0027 (A "data processing unit . . . collects the data from the detectors 140 and reconstructs the image representations or image data therefrom."); *id.* at 7, ¶ 0028 ("[E]ach of the images or image data . . . is loaded and/or stored in an image memory or other like data storage device.")).

The instant Specification also discloses that images are combined by a "data processing unit" (Spec. 6, ¶ 0027) and stored in a "data storage device" (*id.* at 7, ¶ 0028). These disclosures further emphasize that images

are made up of data. Finally, the Specification states that the "thick slice is a uniformly weighted average of the constituent thin slices in a preferred embodiment" (*id.* at 7, ¶ 0029); the disclosure that the thick slices are created by taking an average of the constituent thin slices demonstrates that the thin slices, when combined, are made up of numerical values; i.e., data.

The evidence of record supports a conclusion that those skilled in the art recognize that an image is nothing more than one way of displaying a set of data; thus, combining a set of images and combining the data underlying a set of images are equivalent ways of expressing the same process. The evidence does not support Appellants' position that the language of the appealed claims distinguishes the claimed product from the product made obvious by the prior art.

Appellants also argue that "Wood is only prior art to the extent that subject matter disclosed in Wood is also disclosed in earlier provisional applications" to which Wood claims benefit under 35 U.S.C. § 120 (Reply Br. 2). Appellants argue that paragraphs [0043] to [0046] of Wood, which are cited in the Examiner's rejections, are not entitled to an earlier filing date and therefore are not prior art (*id.*).

This argument does not persuade us of any error in the Examiner's rejection. With regard to the independent claims, the Examiner relies on Wood merely for disclosing a system that includes multiple view ports. (Answer 4, 5-6). Appellants have not alleged that the use of multiple displays or multiple windows within a display was not known in the art at the time the present invention was made. Appellants have conceded, in fact, that "[i]t is common in the medical diagnostic imaging arts to generate a

plurality of axial sections or slices, such as with a CT scanner and display these images on a display or monitor having a plurality of view ports" (Appeal Br. 11). Appellants' argument that some of Wood's disclosure is not prior art therefore does not convince us that the Examiner's rejection is flawed.

Appellants also argue that the rejection of claim 1 is in error because "Wood shows that displays with multiple view ports are known, but makes no suggestion of displaying images with different slice thicknesses," as recited in claim 1 (Appeal Br. 14).

This argument is unpersuasive because claim 1 is directed to a product, not a method. The claimed product must include "a display having a plurality of view ports," but what the claim recites as displayed on those view ports reflects nothing more than the intended use of the claimed device. Claim language that recites an intended use does not limit a claim.

With regard to claim 6, Appellants also argue that that claim "calls for the thickness of the second or thicker images to be n times the thickness of the first (thin) image slices. None of the 3 mm, 7 mm and 10 mm images of Horiuchi are multiples of one another." (Appeal Br. 15.)

This argument is unpersuasive because Horiuchi's disclosure is not limited to the 3 mm and 7 mm thin slices in its working example. As discussed above, Horiuchi also discloses an (unpreferred) embodiment in which the thin slices are not unequally divided; i.e., the thin slices are the same thickness. In addition, unlike claim 1, claim 6 does not require n to be an integer.

Appellants also argue that claim 10 is patentable because "**Claim 10** calls for a means for detecting small objects in the subsets of the first image slices, which small objects have dimensions in the direction of the slice thickness less than the second slice thickness of the second slice images, and a means for projecting outlines of the detected small objects onto the second slice images," and these limitations are not suggested by Horiuchi or Wood (Appeal Br. 15). Appellants make a similar argument for the patentability of claim 18 (App. Br. 17).

The Examiner finds that Wood teaches "detecting small objects or lesions on a particular slice, marking or projecting outlines of said objects, and highlighting or color coding to distinguish between objects," citing Wood at ¶¶ 0047, 0051-0055, 0060, 0065, and 0095 (Answer 6).

We agree with the Examiner that Wood would have suggested the disputed limitations to those of ordinary skill in the art. Wood discloses a "system for displaying anatomical information automatically detected by computer algorithms (computer-aided detection, or CAD)" (Wood, p. 2, ¶ 0015). Wood discloses an embodiment in which the display generates markers that "identify potential regions of interest as determined by image processing steps performed, for example, by processor unit 310 and are intended to direct the attention of qualified personnel to suspicious areas" (*id.* at 4, ¶ 0052). Wood also discloses that a magnified region of interest can be displayed in a separate box, and "[i]f the image in the box 910 contains a nodule or object, such as nodule 920, the system can place an outline 930 around the nodule" (*id.* at 5, ¶ 0060).

We agree with the Examiner that these disclosures would have suggested a means for detecting objects in image slices and a means for projecting outlines of the objects onto image slices. Wood does not expressly state that the objects detected are of any particular size, large or small, but Appellants have provided no basis on which to conclude that Wood's disclosure would not have been enabling for detecting and outlining "small objects having dimensions in the direction of the slice thickness less than the second slice thickness," as recited in claim 10. We agree with the Examiner that Horiuchi and Wood would have made claim 10 prima facie obvious to a person of ordinary skill in the art.

With regard to claim 11, Appellants argue that Horiuchi and Wood do not suggest "color-coding the detected small objects to differentiate them from each other" (Appeal Br. 16).

This argument is also unpersuasive. Wood discloses that the system flags different regions of interest with "markers or identifiers [that] are preferably visually different (e.g., different shape, size or color)" (Wood, p. 4, ¶ 0052). Wood also discloses that "[n]odules can have circles of differing colors representative, for example, of whether a nodule has been considered, highlighted, or otherwise evaluated by a physician" (*id.* at 5, ¶ 0065). We agree with the Examiner that color-coding different detected objects, as recited in claim 11, would have been obvious to a skilled artisan based on Wood.

Appellants also argue that Horiuchi and Wood do not suggest the limitations of claims 13 and 14, requiring means for sequentially progressing

through the second (thick) image slices and means for designating regions for close review (Appeal Br. 16).

This argument is also unpersuasive. Wood teaches that "[i]n the prior art, a physician scans through a series of axial CT sections" (Wood, p. 4, ¶ 0050) and that blood vessels "can be identified by finding contiguously aligned flecks in adjacent axial sections" (*id.* at 4, ¶ 0049). These disclosures show that sequentially progressing through a series of CT images was common in the art, and would have made obvious a means for sequentially progressing through either thick or thin CT image slices.

Wood also discloses means for designating regions for close review, as recited in claim 14. As discussed above, Wood discloses that regions of interest, determined by image processing carried out by a processor, are marked "to direct the attention of qualified personnel to suspicious areas" (see *id.* at 4, ¶ 0052).

Appellants' arguments do not persuade us that the Examiner's rejection of claims 13 and 14 is in error. Appellants' similar arguments with regard to claim 15 (Appeal Br. 16-17) fail for the same reason.

Appellants also argue that claim 15

> calls for obtaining a plurality of first images of a first thickness. Claim 15 further calls for these first images to represent contiguous slices. . . . Although the 3 mm and 7 mm images of Horiuchi are . . . contiguous to each other, Horiuchi's 3 mm and 7 mm images are not of the first thickness, but are of different thicknesses.

(Appeal Br. 16.)

This argument is also unpersuasive. As discussed above, Horiuchi's disclosure is not limited to the 3 mm and 7 mm thin slices in its working

example. Horiuchi's disclosure that "the division is *preferably* unequal division" (Horiuchi, col. 1, ll. 66-67, emphasis added) describes an embodiment, even if not preferred, in which the thin slices are divided equally; in other words, they have the same thickness.

CONCLUSIONS OF LAW

The cited references disclose or would have made obvious a system and method that combines thinner "images" (or "image slices") to form thicker "images" (or "image slices"), as recited in independent claims 1, 6, and 15, as well as the disputed limitations in the separately argued dependent claims.

SUMMARY

We affirm the rejection of claims 6-18 as obvious in view of Horiuchi and Wood, and the rejection of claims 1-5 and 20 as obvious in view of Horiuchi, Wood, and Lonn.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED

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